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ABSTRACT

This publication presents the activities pertaining to the first goal of this activity guide series. The activities in this publication focus primarily on the availability of resources, forms of energy, natural laws, and socioeconomic considerations. These materials are appropriate for middle school and junior high school students. These activities, organized by objective under the concepts listed, are interdisciplinary and can be used in a variety of ways. The activities are simply ideas of things that students can do to help them understand the concepts. It has been left to the teacher to choose and implement these ideas as desired. Activities range from an energy unit "treasure hunt" to dramatizing an Inca coronation. (MR)

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SOURCES of energy

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ENERGY AND MAN'S ENVIRONMENT

Activity Guide

An Interdisciplinary Teacher's Guide to

Energy and Environmental Activities

Section One

SOURCES OF ENERGY

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Illustrations and graphics were prepared by Chloe Poole and Omer Gosnell.

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SOURCES OF ENERGY

Introduction

Most of the world energy resources originated as solar radiation. About 23% of this energy is stored as water and ice as a consequence of the hydrologic cycle. When collected in rivers and reservoirs at some altitude the stored water is used to supply about 4% of the U.S. energy demand by converting the energy in falling water to electric power in hydroelectric facilities. A much smaller amount, less than one-hundredth of one percent is converted to plant material by photosynthesis. A miniscule amount of the plant material finds its way into coal forming swamps or petroleum forming plankton-rich ocean waters. Recent investigations into the origin of fossil fuels (especially oil and natural gas) suggest that the genesis of these valuable energy sources is closely connected with the development of the ocean basins and continents themselves. Of practical value is the knowledge that oil, natural gas, coal, and most non-fuel minerals do not occur universally but are unevenly distributed in areas bordering ancient and modern continents.

Significant to our use of solar-derived energy sources is the fact that we presently rely on petroleum and coal for 95% of our energy. And we are using these resources much faster than they are being formed by geologic processes. The result is sequential depletion of various sources according to which is the most available and economical.

In the mid 1800's wood was the most used energy source in the United States. By 1900 coal provided over 70% of the energy. In the mid 1960's oil accounted for 60%. Today, about 75% of the energy used in the U.S. is derived from oil and gas, with coal providing 20% and hydroelectric and nuclear the remainder. Due to political and economic considerations, the U.S. is beginning to emphasize coal production and other

energy sources relatively abundant in this country.

Nuclear fission reactors now supply approximately two percent of the total U.S. energy and can be expected to increase their share slowly. Hydroelectric sites have been exploited and will not markedly increase unless national parks and wilderness areas are opened for development. Clearly the new technologies discussed in Future Sources will become increasingly important as current conventional sources are depleted and become more expensive.

Activities in this section focus principally on the availability of resources, forms of energy, natural laws, and socio-economic considerations.

Dan Horn

EVALUATION

Sources of Energy

The ENERGY and MAN'S ENVIRONMENT program actively seeks your ideas, comments, and general suggestions about this Activity Guide. If you feel there are ways this Activity Guide could be improved, or if more or different learning objectives or activities could be added, please let us hear from you. We plan to contact you in the near future to ask your opinion about the activities which you have used in your classroom. In anticipation of our request, we ask that you keep a careful record of all specific activities which are tried in your classroom. Please rate the effectiveness of each activity according to the following scale.

Chapter Title	Concept Number	Objective Letter	Activity Number	not at all useful 1 2 average 3 highly effective 4 5	Comment Suggestion
			EXAMPLE		
Sources	III	B	2	✓	students enjoyed very much
Sources	III	B	5	✓	students enjoyed very much
Uses	II	A	3	✓	too difficult for age level

EVALUATION Sources of Energy

Chapter Title	Concept Number	Objective Letter	Activity Number	not at all useful 1 2 average 3 4 highly effective 5	Comment Suggestion

EVALUATION Sources of Energy

Chapter Title	Concept Number	Objective Letter	Activity Number	not at all useful 1 2 average 3 4 highly effective 5	Comment Suggestion

EVALUATION Sources of Energy

Chapter Title	Concept Number	Objective Letter	Activity Number	not at all useful 1 2 average 3 4 highly effective 5	Comment Suggestion

concept: I - Energy is the capacity to do work and is subject to natural laws.

sources

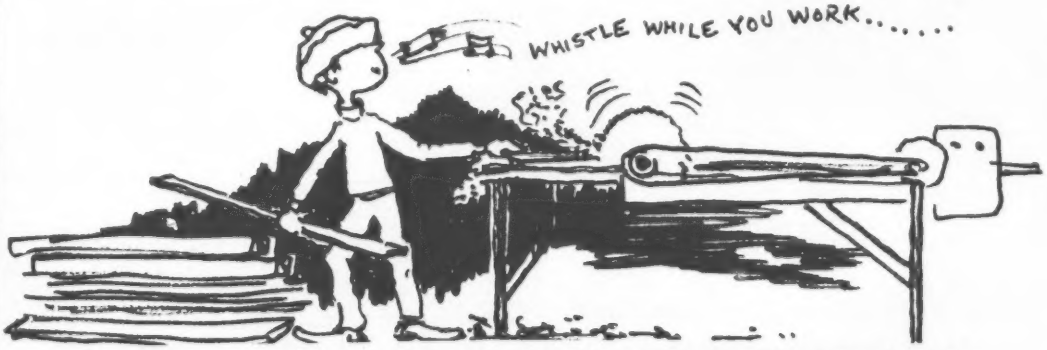
objective: A - The student will understand that energy is the capacity to do work and is subject to natural laws.

activities

1. Write two separate descriptive sketches which highlight changes in your family's activities for an average day if you have no automobile and if you use one.

2. Keep a daily journal of automobile use in your family for one week.

3. Explain ways in which "work" contributes to your well-being.



4. Write a series of short stories or draw cartoons illustrating the history, uses and efficiency of early types of energy:

   a. man
   b. beast of burden
      1. transportation
      2. treadmill to power simple machines
   c. windmill
   d. water wheel
   e. wood

5. Using a regular junior high school science textbook for directions construct an electric motor (iron core, copper wire, permanent magnet, wooden base with oiled bearing slots) to illustrate energy's capacity to work.

6. Using the motor's motion, make the motor do productive work. (Supply pulleys, wires, string, etc.) Art students may want to create moving art objects.

7. Illustrate that the energy in a peanut is capable of doing work by a) burning the peanut; b) using the heat to turn a paper pinwheel (or plastic); c) increasing the temperature of one cc of water.

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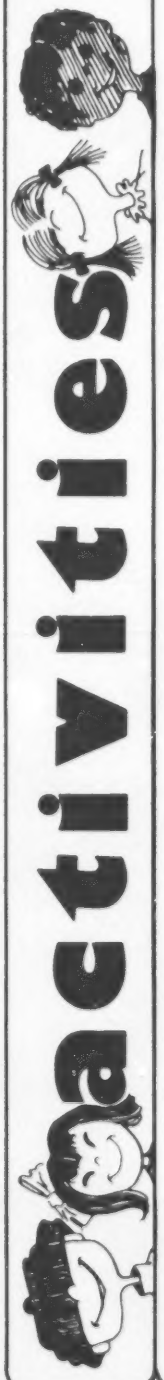
concept: I - Energy is the capacity to do work and is subject to natural laws.

sources

objective: B - The student will be able to explain the meaning of "work."



activities

1. A classroom is likely to have individuals with a variety of energy sources (strength) to do work. Interview other students and list action they consider to be work (easy - hard).

2. Have three individuals lift weights until the maximum each can lift has been determined. Then ask the students to run around the block and try again. Have they depleted some of their energy resources and therefore reduced their ability to do work? Explain.

3. Ask parents the nature of their job and the personal and external energy requirements to support it. Record and compare the findings with other class or group members.

4. Contact the state employment department or office of human resources to determine how the people of their state are employed and in what numbers. Rate the occupations by their amount of energy use. Use the U.S. Census of Commercial Activity - broken down by state, county, city.

5. List three simple mechanical devices that multiply a person's ability to do work.

6. Make a group collage showing different kinds of work being performed by various devices and persons.

7. Using the collage in Activity 6, write essays or hold debates or discussions which clearly define the differences between the scientific concept of work and the socio-philosophic concept of work. Certain ethical issues about gainful activity will rise. Some background data for this activity will be found in Work in America.

2

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concept: I - Energy is the capacity to do work and is subject to natural laws.

sources

objective: C - The student will recognize that energy units measure the ability to do work.

activities

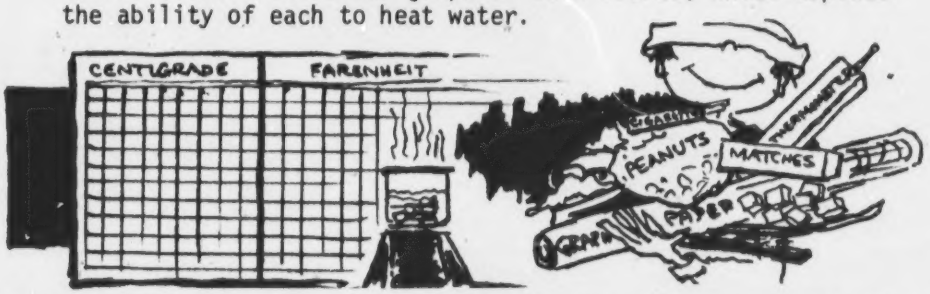
1. Using every appropriate book you can find, conduct a treasure hunt for units which measure various forms of energy use. (Example: electricity in watts, ohms, and amperes; food in calories, oil in British thermal units.) Allow as much time as you feel is necessary. Group work is preferable.

2. Write a report about the controversy that exists between Congress and Detroit automobile makers over automobile engine design. Use legislative hearing documents, the speeches in the Congressional Record, and articles in newspapers and magazines as data sources.

3. Paint a mural depicting the myriad of measurements that surround man. Try to symbolize the interrelatedness of technology and modern man.

4. Make a collage or construction depicting a number of energy measurement devices and units.

5. Take three sources of energy - a peanut, a sugar cube rubbed in cigarette ashes (the necessary catalyst), and a match stick. Burn each to heat 10 cubic centimeters of cold water. Measure the rise in temperature with both a Centigrade and Farenheit thermometer. Make a bar graph of each source, which depicts the ability of each to heat water.



6. Using the three sources of energy in Activity 5, determine how long these sources will keep a paper windmill moving (working) before the windmill stops moving. (Use a stop watch.) Make a bar graph and compare it with the graph made in Activity 5. Is the ability to raise temperature the capacity to do work?

7. Using an auto repair manual (Chilton, Motor, etc.) make a chart to compare engine statistics of brake horsepower, displacement, compression ratios, and number of carburetor barrels. Discuss the combinations of variables that result in the approximate same BHP.

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concept: I - Energy is the capacity to do work and is subject to natural laws.

sources

objective: D - The student will be familiar with the difference between kinetic and potential energy.

activities

1. Look up the words potential, kinetic, and motion in one or more dictionaries. Write a sentence for each different way these words can be used. Clearly show that you understand the various meanings.

2. Using your school grounds as a laboratory and the scientific definitions for kinetic and potential energy, design a demonstration to illustrate the difference between these two forms of energy.

3. Demonstration: Above a soft styrofoam block place two identical weights - one at six feet and one at one foot. Drop them both onto the styrofoam. The varying degree of damage to the block is related to their original distance above the floor - that is to say their potential for doing work. Measure, record and report your findings.

4. List as many examples of potential energy (water behind a dam, electricity in a battery, the weight held above the sore toe) as you can in 10 minutes. Compare and discuss differences in your lists.

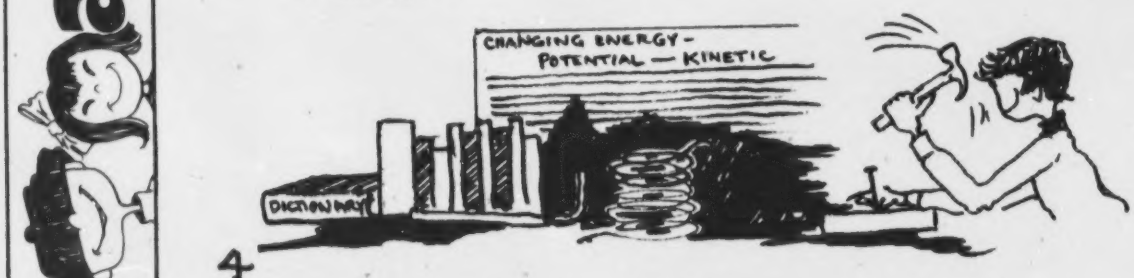
5. List as many examples of kinetic energy (water flowing through a pipe, electricity in a wire, the weight falling) as you can in 10 minutes. Compare and discuss differences in your lists.

6. Identify sites where potential energy is stored in your area. Map and classify these.

7. Find five examples of kinetic energy on your school ground.

8. Identify and describe the changing energy requirements (kinetic and potential) in the act of driving a nail with a hammer.

9. Examine your town for two examples of where kinetic energy is stored and identify the form in which that storage occurs. As a group make a collective list of your town's sources of kinetic energy.



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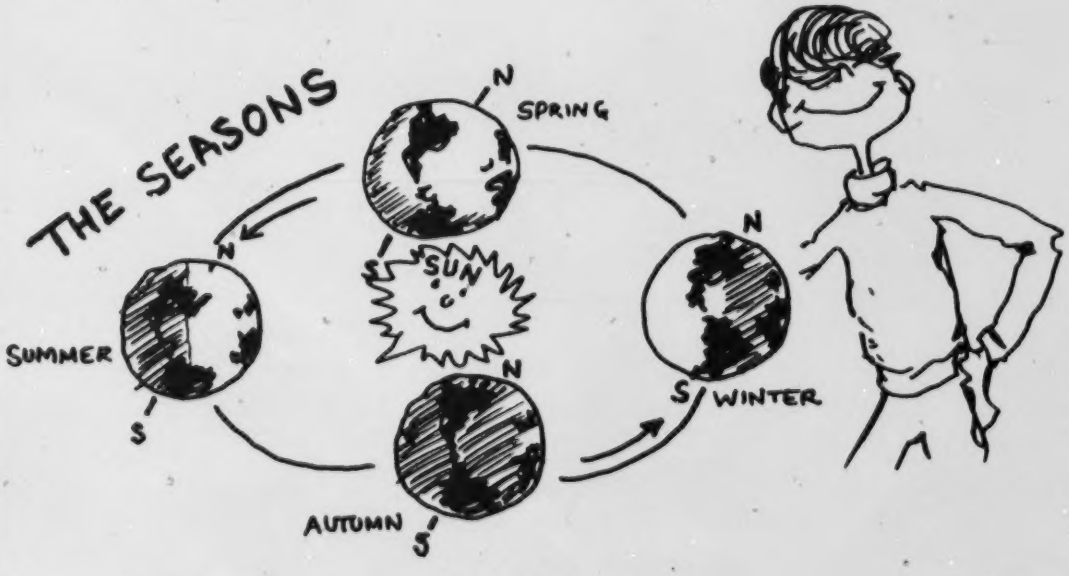
concept: II - Most specific forms of energy originated with the sun.

sources

objective: A - The student will understand the physical arrangement of the solar system.

activities

1. Draw a diagram showing the position of the planets in relationship to our sun.
2. Using ping-pong balls, tennis balls, soccer balls, etc. construct a three dimensional model of the solar system. Hang the model in your school room or hallway.
3. From reference books in the school or community library, determine the distance from our sun to each of the principal planets in the solar system.
4. Using the Annual Index for the National Geographic, find and read several articles relating to the solar system.
5. Compute the energy from the sun which is available to each planet.
6. Diagram the physical arrangements that cause seasonal changes on earth. Explain in a series of paragraphs how varying changes in heat energy create the visible changes humans naturally observe during these seasonal changes.



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concept: II - Most specific forms of energy originated with the sun.

sources

objective: B - The student should be familiar with the laws of gravitational attraction that keep the planets orbiting the sun and move the tides on earth.

activities

1. It has been suggested that tidal energy is a large untapped source of energy. Consider yourself a member of a commission to evaluate a proposal to use tidal energy. List the issues and conditions the commission will study. What would be the recommendations?

2. Describe the limitations and advantages of tidal flows as a source of energy.

3. Predict the probable value of tidal energy if only the gravitational field of the sun were involved.

4. Investigate the French tidal installation at Nantes Estuary and report orally to the class on your findings.

5. Construct a model of the suggested tidal dams on the Bay of Fundy.

6. Identify other estuaries where tidal flows could be harnessed and map these on a map of North America (Africa, Asia, Europe, Australia or South America).

7. Demonstrate the force of gravity on plants with the following experiment:

   a. Soak six corn seeds for 24 hours in water.

   b. Place soaked corn seeds on moist paper towels in a Petri dish.

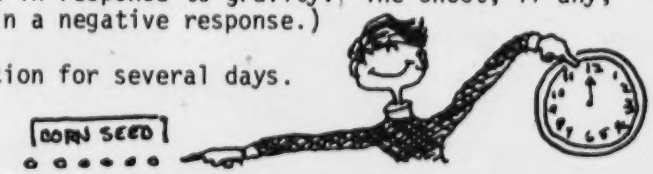
   c. Make sure the seeds are secure in the dish by placing the top snugly on the Petri dish and the corn. (Increase the quantity of moist paper towels to ensure this condition.) Tape the Petri dish shut with transparent tape.

   d. Place the Petri dish on its edge in a dark place (drawer).

   e. After roots have begun to grow rotate the dish 90°. Allow to grow for an additional 24 hours.

   f. Diagram and discuss the response of the corn root. (Roots will bend down in response to gravity. The shoot, if any, will bend up in a negative response.)

   Continue the rotation for several days.



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activities

Concept II
Objective B

8. Arrange several different sized balls to represent the relative positions of the earth, sun and moon during spring and neap tides.

9. Make a bulletin board illustrating the relative positions of the earth, sun and moon during spring and neap tides. Include descriptive statements of the forces and processes involved.

10. Take a field trip to the coast during the month of May to observe tidal fluctuation in an estuary during spring tides. Measure differences; compare with tidal records during the year. (When would be the best time to go clam digging?)

11. View the film "The Tides" by Encyclopaedia Britannica Films.

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concept: II - Most specific forms of energy originated with the sun.

sources

objective: C - The student will understand that the sun's radiation produces surface and atmospheric heat.

activities

1. Demonstrate the heating effect of sunlight by putting a pan or bottle of water in the sun and compare the temperature with a similar quantity and container placed in the shade.

2. Remove the handle from an old umbrella. Line the inside of the canopy with aluminum foil. Point it at the sun and concentrate the focused energy on a beaker of water. Describe the result.

3. Measure the electrical output of a solar cell when it is exposed to direct sunlight and when it is covered. Cadmium sulfide cells are not appropriate because they merely change their resistance in different light levels.

4. Following a warm sunny weekend observe the effects of solar radiation on human skin. Considering the fact that the sun is 93,000,000 miles (155,000,000 kilometers) away from the earth, what generalizations can be drawn concerning the power of the sun?

5. Using adhesive tape, tape initials on arms or legs. Expose the arms or legs to the sun for different periods of time (not to exceed 30 minutes - you'll burn up). Compare and discuss results.

6. Write a poem demonstrating the effect of the sun's heat upon the geographic forces which affect the earth and people's responses to them.

7. Operate a cold-frame successfully in January.

8. Visit a greenhouse and measure temperature and humidity differences at different times of the day and year. Describe and illustrate the "greenhouse effect."

9. Paint a mural depicting many specific forms of energy and their relationship to the sun.

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concept: II - Most specific forms of energy originated with the sun.

sources

objective: D - The student will explain how the sun contributes to earth's life forms.

activities

1. Identify ways in which solar energy is "stored." List as many forms of stored solar energy as you can in 10 minutes.

2. Demonstrate the storage of solar energy in plant material by burning a peanut.

3. Compare the starch in a plant kept in the dark for 48 hours to a plant in sunlight. Remove chlorophyl in a leaf by immersion in hot alcohol. Place leaf in Petri dish and cover with iodine. Pour off excess iodine. Look for blue-black color which will show the starch produced by photosynthesis. Coleus leaves work well.

4. Raise bean plants until leafed-out plants have cotyledons above the surface. Remove the cotyledons. Place half of the plants in the dark for two weeks or more. Then remove all the plants from the soil and dry them until their weight is constant (this probably will require another week). Weigh the plants. Record results and make observations about findings.

5. Use mirrors to reflect sunlight against the surface of a can and the surface of a green plant. Measure and compare the differences in temperature of the two surfaces. Calculate the efficiency of the plant surface to utilize light versus that of the surface of the can. Measure temperatures on the back of leaf, can and mirror. Explain differences.

6. List major energy sources that come from solar radiation.

7. Explain the current human uses of solar energy:
   a. photosynthesis
   b. solar cells
   c. solar furnace
   d. solar water heating

8. Using the Life Nature Library, graphically illustrate animal adaptation to environments where the amount differs dramatically (arctic deserts, high mountains, deserts, tropical rain forest, etc.)

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concept: II - Most specific forms of energy originated with the sun.

sources

objective: E - The student will understand that adoration of the sun's energy has contributed to the development of the religions of the world.

activities

1. Speculate as a group about the reasons why primitive people often view the sun as a sacred entity.
2. Write and sing a song in praise of the sun as it might have been done by an ancient people.
3. Write a report on Zoroaster and the religion centered about him.
4. Collect native American poetry about the sun. Illustrate your anthology.
5. Research ancient civilizations that have revered the sun. (Stonehenge, Egypt, Mayan, Inca, Japan, etc.)
6. Read Stonehenge Decoded.
7. Dramatize an Inca coronation.

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concept: II - Most specific forms of energy originated with the sun.

sources

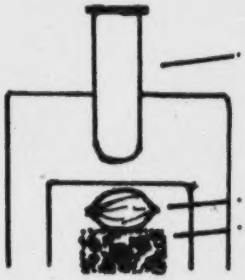
objective: F - The student will know that the sun's energy can be stored for later use.

activities

1. Construct a geologic time-line that shows the relationship of fossil fuel development (coal, oil, gas) to their discovery and use by modern man.

2. Collect samples of coal and oil. Describe their physical properties.

3. Demonstrate the storage of solar energy in plant material. Set it up this way:



Demonstrate the energy (in calories) in the nut by burning the nut and measuring the temperature rise of the water.

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concept: II - Most specific forms of energy originated with the sun.

sources

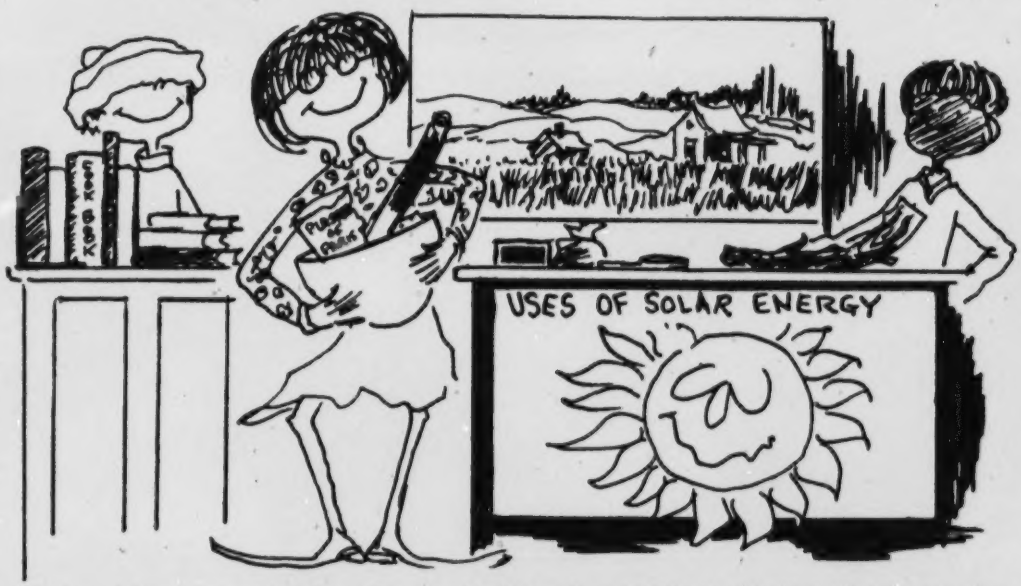
objective: G - The student will understand that the sun can be used directly by humans.

activities

1. Build a solar furnace made of plaster of paris and aluminum foil in a parabolic shape, with the heat collector at the focal point of the parabola. Use the collector to bring water to a boil. Boil some eggs for snacks.

2. Using a soft piece of pine or fir with a magnifying glass to collect the sun's rays, sketch a picture. (Watch out for villainous children with pyromaniac tendencies and sadistic impulses in their interaction with others.)

3. Build a solar furnace made of plaster of paris and aluminum foil in a parabolic shape, with the heat collector at the focal point of the parabola. Measure and log temperature differences at different hours of the day under different atmospheric conditions.



4. After researching the agricultural practices in the wheat country of Eastern Oregon and Washington, write an essay evaluating the energy sources used to farm in this area.

5. In a county or city library look for old cookbooks. Look up old ways of making preserves from strawberries or other berries, using direct solar energy. Find out if these methods were used in all areas or only in specific parts of the United States. Why the variation?

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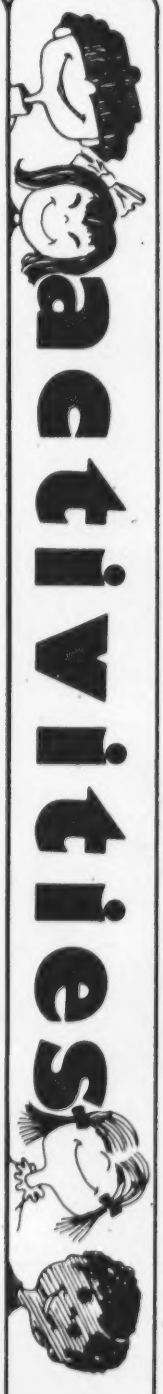
concept: III - Natural processes are constantly forming and concentrating fossil fuels, but at a rate much slower than these sources are being used.

sources

objective: A - The student will understand the biological, chemical and geologic method of formation of each fossil fuel - coal, oil, gas and peat.



1. Draw a map of your state/region and identify the location of the principal mineral resources.
2. Identify on a map of your state/region the location of coal, oil, or natural gas deposits.
3. Contact your state department of natural resources (or equivalent) and determine the availability of state/regional resource information.
4. Discuss the meaning of natural process. Define the term and illustrate it in action by developing a mural.
5. Make a list of the natural processes that are occurring in your neighborhood, state, region, et al.
6. Draw a picture of a coal field as it may have appeared 15 million years ago; 5 million years ago; 1 million years ago; 50,000 years ago; 10,000 years ago.

7. Prepare a hypothetical time-line showing the evolution of coal.
8. Find out where coal can be found (purchased) in your community.
9. Write a letter to a major oil company asking if they have any materials which depict the natural processes by which their energy source was formed.

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concept: III - Natural processes are constantly forming and concentrating fossil fuels, but at a rate much slower than these sources are being used.

sources

objective: B - The student will understand the slow rate of formation of fossil fuels and the rate at which these fuels are being used today.

activities

1. Find in the library as many references as possible which describe or depict natural energy forming processes.

2. Using the walls of the classroom, depict geologic time as the fossil fuels were being deposited, the first probable use by poeple, the time when commercial use of the fuel began, and the rate at which the fuel is being used today.

3. Contact major commercial suppliers of fossil fuels and have them supply materials which deal with the rates of concentration and use of their fuels.

4. Draw a bar-chart which depicts the increased use of fossil fuels for the last 200 years. Prepare a chart for each fuel. Convert the value of each fuel to a standard energy measure (BTU, barrels of oil, etc.) and compare the total energy consumption in the same way.

5. Describe in a scenario the geologic life of a peat bog - "I am your peat bog."

6. Locate on a map of the world the peat bog areas.

7. Measure the rate of methane production at your local sewage treatment plant.

8. Using articles from news magazines, calculate the total known world reserves of fossil fuels. Assume that the formation of the fuels began 600,000,000 years ago. How much of the formation occurred annually? Given the present rate of consumption, calculate the year when all fossil fuels will be exhausted.

9. Map the location of Gondwana Land during the time that fossil fuels were being formed. Speculate about the present creation of future fossil fuels as a result of your geographic studies.

10. Visit a bog. Using soil corer, sample various levels in a bog. Analyze core samples for organic matter, PH balances, and oxygen content.

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concept: III - Natural processes are constantly forming and concentrating fossil fuels, but at a rate much slower than these sources are being used.

sources

objective: C - The student will understand the geologic origin of non-fossil fuel energy sources in the earth such as radioactive minerals.

activities

1. Demonstrate a chain reaction in atomic energy. A simple, quick and safe way of demonstrating this, using table tennis balls, is by the following procedure:

   STEP 1: Use a large aquarium that represents a reactor in which the experiment takes place. Place mousetraps on the bottom to represent the fuel. Have enough table tennis balls to cover each mouse trap and use two balls where possible. These balls represent the neutrons as they are contained within the atoms.

   STEP 2: Have all traps set with ping pong balls before class starts. Review what is meant by a chain of reactions. Have a student throw a table tennis ball into the aquarium. Review what has happened and, if possible, show a slow motion film of the same thing. It is also helpful to have a chart showing what actually happens.

2. Chain reactions also happen in other media. For example, an English class might discuss how rumors get started or the chain reaction of gossip in human situations.

3. Map the location of the major uranium mines in the world. Identify by country and by type of geologic formation in which the several types of uranium deposits are found.

4. Visit a uranium mine and have a local geologist explain what you will see.

5. After research, diagram the process used in a self-contained geothermal electric generating plant. Diagram a non-contained geothermal electric generation process. Write an explanatory series of paragraphs outlining the environmental impact of the two contrasting forms of extracting geothermal energy.

6. Visit a local nuclear power plant.

7. Have students set up cloud chambers according to instructions which may be found in most physical science textbooks. (See, for example, Introductory Physical Science, published by Prentice-Hall.) Students should make brief written notes of their observations.

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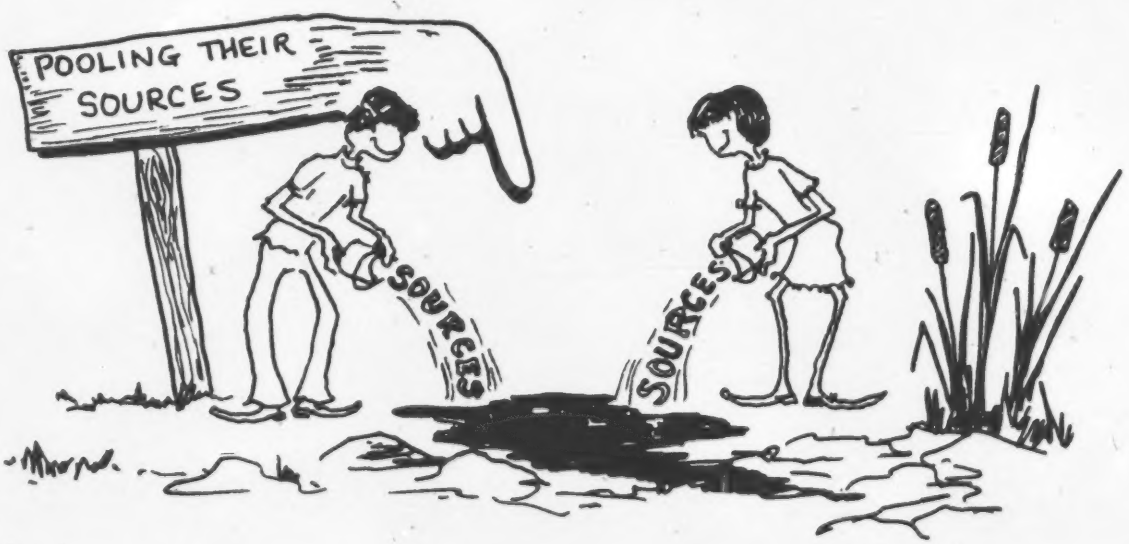
Concept III
Objective C

8. Pairs or groups of students should expose Polaroid film to radioisotopes according to instructions in the commercial kits available. (Prentice-Hall's text, named above, gives complete instruction for this activity. Kits are available from the publisher.)

9. Each student should expose Geiger counters to a radium dial watch or clock, or to a radioisotope cube, and observe the counter's behavior. Radium is not used in clocks and watches today, but old clock faces with radium dials may frequently be found. Suppliers of scientific materials offer relatively safe radiation sources for such an activity.

10. Students should read at least two books or articles, one favoring nuclear plants, and one opposing them. The teacher could contribute by interpreting some of the more technical material concerning pollution problems and biological hazards associated with any form of ionizing radiation. He might also describe briefly the operation of conventional power plants - hydroelectric and fossil-fueled. Students should understand that all methods of producing electrical power cause some undesirable effects.

    The student should list and document both the benefits and hazards he believes nuclear power plants represent. He should be able to take a position for or against construction of a nuclear plant near his home and be prepared to defend his views.



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concept: IV - Energy resources are unevenly distributed around the earth.

sources

objective: A - The student will understand why there is high heat flow in some areas but not in others, thereby affecting geothermal energy potential.

activities

1. Using a map of the world, identify all the locations where geothermal activity might be used as a potential source of energy. Evaluate whether it would be practical to use each of those sources to produce energy.
2. Debate the aesthetic qualities that should be considered for the use of a geothermal source for energy.
3. Describe the limitations and advantages of geothermal sources of energy.
4. Build a topological 3-D map of the U.S. showing known potential energy sources in the form of a standard measure (BTU).
5. Do the same for the U.S.S.R., the Peoples' Republic of China, or any country of your choice.
6. Do the same for the whole world.
7. Secure maps of areas in the Pacific Northwest which have been made available for geothermal lease.
8. Visit a hot springs area with an experienced local geologist. Measure energy output and calculate how many houses could be heated by the spring.

9. Research the Geyserville, California geothermal electric energy production activity.
10. Write to the Klamath Falls, Oregon, Chamber of Commerce or to Oregon Institute of Technology, Klamath Falls, Oregon, to secure information which shows how geothermal power is used in this city.

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concept: IV - Energy resources are unevenly distributed around the earth.

sources

objective: B - The student will understand that some geographic locations of wind, riverine, tidal and solar electric power plants are better than other locations.

activities

1. Locate those regions which have hydroelectric potential in the North American continent.

2. Identify the prime geographic locations for wind generation of energy in your area or in the Pacific Northwest.

3. Using U.S. Weather Bureau data, or a comprehensive atlas, list the 10 or 20 largest cities of the U.S. in order of their annual hours of sunshine.

4. Investigate the energy potential in tidal power. Find out about the hydroelectric power plant on the Nantes estuary in France, then find out where there are other potential sites. Could this be a useful source on Puget Sound? Off the coast of California? Near Cape Cod?

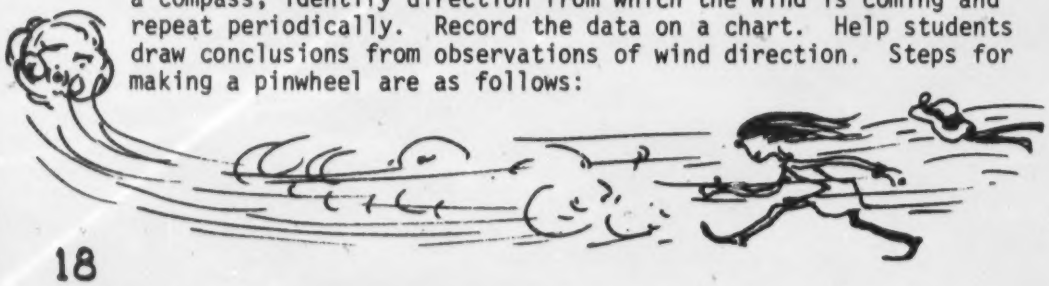
5. Find out what is meant by the energy available by means of a thermal gradient, as in the temperature difference between ocean surface water and deep waters, such as in the Atlantic Current.

6. Identify and map the air flow patterns in your area. Pay particular attention to venting areas.

7. On a windy day hand out paper streamers. Tell students that they are going for a walk around the schoolyard. Stop in front of the flag and ask students to observe and discuss its movement. Ask if streamers are blowing in the same way as the flag.

   Ask students to look about to see if anything else is being moved by the wind - such as leaves, tree branches, clouds, smoke from chimneys.

8. Construct paper pinwheels and have students take them outside. Try to locate a spot on the school ground that receives the most wind. Face different directions to identify the direction the wind is blowing. Name it by sighting a familiar landmark. Using a compass, identify direction from which the wind is coming and repeat periodically. Record the data on a chart. Help students draw conclusions from observations of wind direction. Steps for making a pinwheel are as follows:



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activities

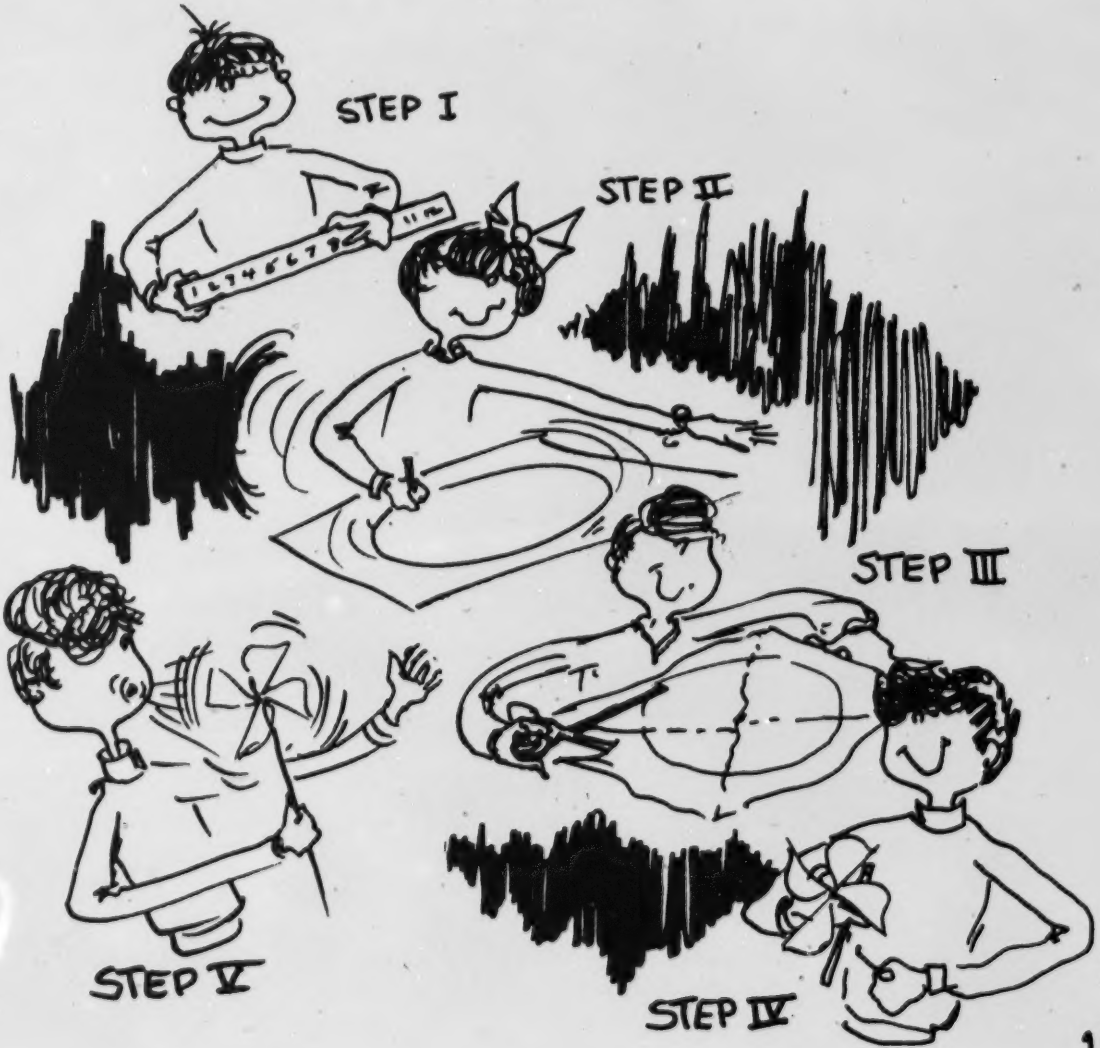
Concept IV
Objective B

a. Cut an 8 inch square of heavy paper.

b. Draw 1 inch circle in center of paper and cut from corners to circle.

c. Bend corners 1, 2, 3, 4 over to center and insert straight pin through all ends.

d. Pin to eraser of pencil.



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concept: IV - Energy resources are unevenly distributed around the earth.

sources

objective: C - The student will know the current locations of present and possible future fossil fuels.

activities

1. Construct a map of the world which shows the location of fossil fuel energy sources (coal, oil, natural gas).
2. Construct a map showing world locations of major uranium, wood, hydroelectric and geothermal resources.
3. Draw a map of a specific continent and show the location of energy sources.
4. Construct a chart showing the evolution of fossil fuels (coal, oil and gas) from the original plant life to discovery by man.
5. Write and tell a myth about how the energy resources came to be unevenly distributed around the earth.
6. Make a collage showing the transition of growing plants to anthracite coal- plant material, peat, lignite, bituminous coal, anthracite coal. Include visual materials which indicate the influence of time, heat and pressure.
7. Map the U.S. showing the location and quantities of energy sources.
8. Illustrate the relationship between energy usage and geographical location by mapping the world's 10 most significant industrial areas.

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concept: IV - Energy resources are unevenly distributed around the earth.

sources

objective: D - The student will understand that nations with abundant resources have advantages over those who must purchase their energy resources from others.

activities

1. Using an almanac list the ten poorest countries of the world in terms of per capita income. Using a map showing distribution of energy resources, see if there is any correlation (plus or minus) between economic standing and resource availability.

2. Graph the oil incomes of Iran, Saudi Arabia, Kuwait, and Venezuela annually from 1970 (?) to the present. What kinds of advantages and problems arise within a country as a result of these changes?

3. What percentage of the coal, oil and hydroelectric used in Japan must be purchased from other countries? Compare with Egypt, Russia, the U.S., or other countries of your choice.

4. Make a time line for man's history. Find magazine pictures that depict sources of energy used from earliest times and mount them in the proper time slots on the time line. Make a mural with your pictures.

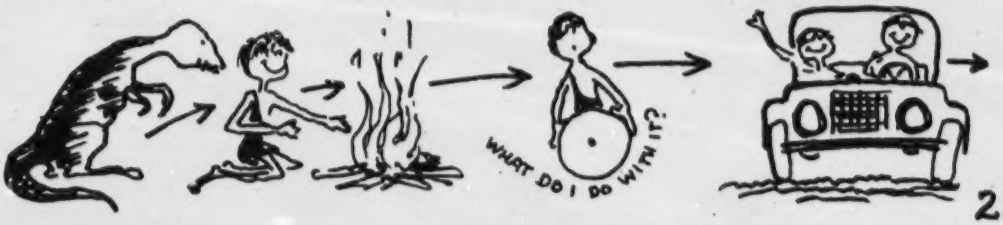
5. Report the history, uses and efficiency of early types of energy:

   a. man
   b. beast of burden
      1. transportation
      2. treadmill to power simple machines
   c. windmill
   d. water wheel
   e. wood

6. Countries which need to import energy or energy resources may have to transport these materials over great distances. What international tensions have resulted from the need to protect these transport lines? Research these occurrences.

7. Compare energy resources available in continental U.S. with those in Hawaii, Australia, Japan, Egypt, India and/or Alaska.

8. Locate on a world map the world's major deposits of oil shale and tar sands.



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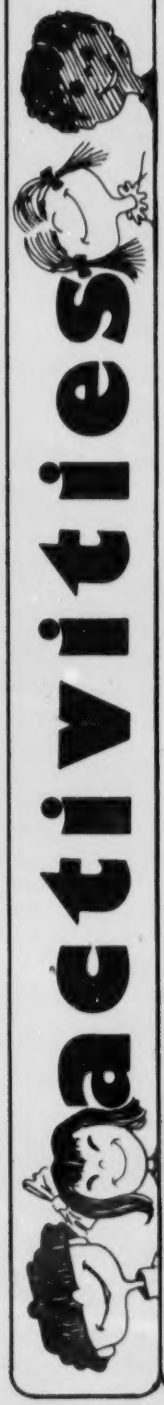
concept: V - High grade (concentrated) energy sources occur in relatively small amounts, and take relatively smaller amounts of "outside" energy to find and recover.

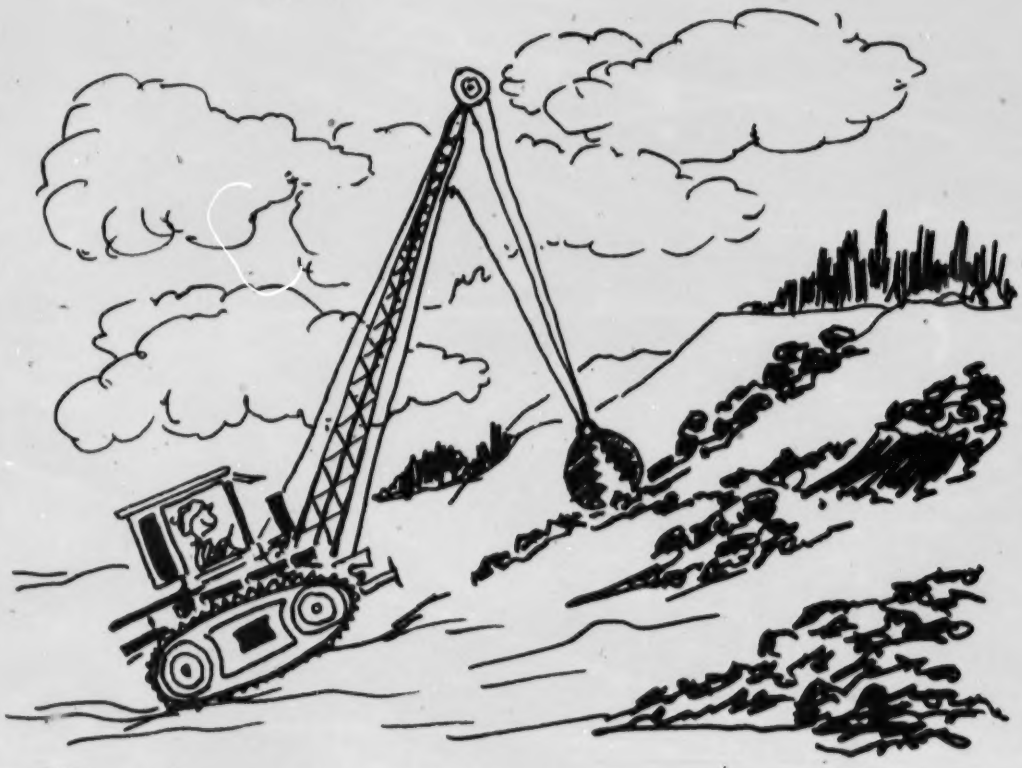
sources

objective: A - The student will understand the concept of high grade for each form of energy.



activities

1. Compare the environmental impact of a coal surface mining operation for concentrated and dilute coal deposits. Use the EPA environmental impact analysis format.
2. Now compare the economics of the mining operation described above.
3. How does energy usage for mining operations compare when mining concentrated and dilute energy materials? Graph the various energy forms.
4. Identify a mining operation in your area. Interview the operator, discussing the comparisons of mining concentrated and dilute materials.
5. Would the environmental and economic impact of mining low grade uranium ores yield a net energy gain? Compute to find the answer.



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concept: V - High grade (concentrated) energy sources occur in relatively small amounts, and take relatively smaller amounts of "outside" energy to find and recover.

sources

objective: B - The student will know energy costs for production of various fuels.

activities

1. Compare the net energy value for production or recovery and preparation of the following:

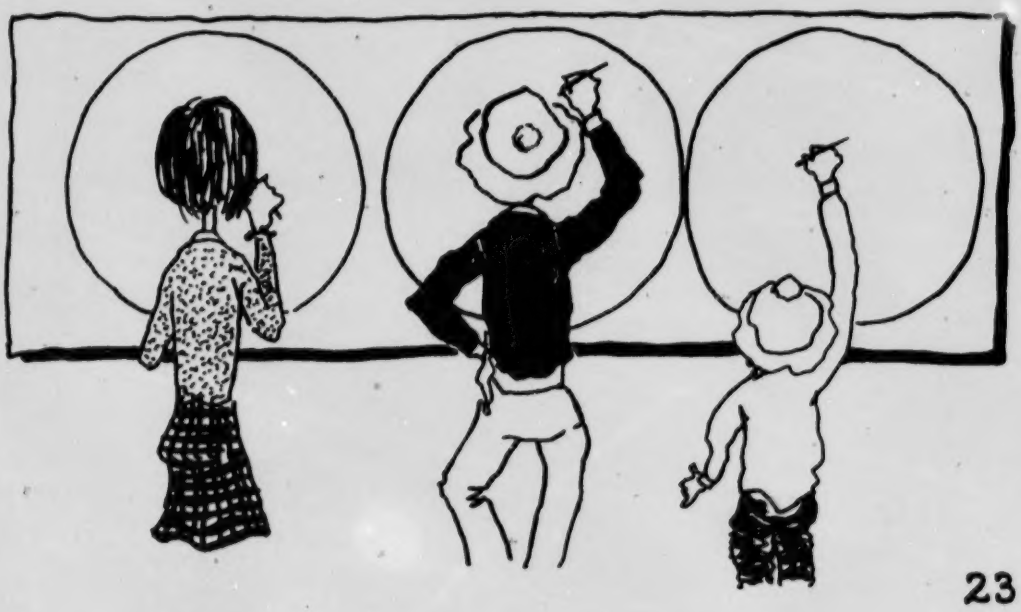
   a. oil
   b. coal
   c. uranium
   d. oil shale
   e. geothermal
   f. solar
   g. others

   Use circle graphs to depict your findings on a wall chart.

2. Graph energy product vs. energy costs (in energy values - not dollars) for those sources investigated.

3. Make a bar graph or graphs to compare net energy costs of oil pumped from fields in southern U.S., Alaska, Venezuela, Iran, the North Sea, if all the oil were to be delivered to Washington, D.C. (or another destination of your choice).

4. Compare energy costs for production of various liquid fuels. (Natural gas, propane, kerosene, gasoline, jet fuel - include by-products tar, sulphur, asphalt, etc.)



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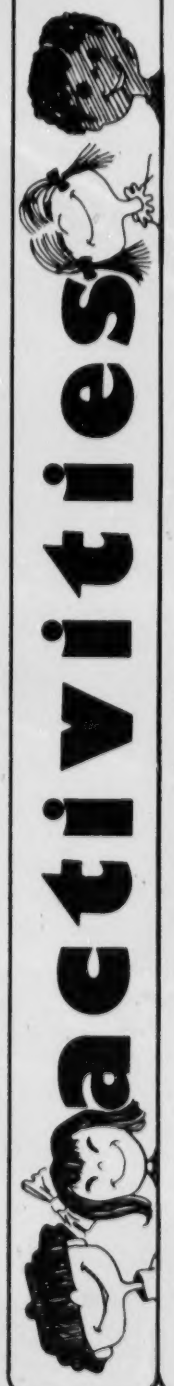
concept: V - High grade (concentrated) energy sources occur in relatively small amounts, and take relatively smaller amounts of "outside" energy to find and recover.

sources

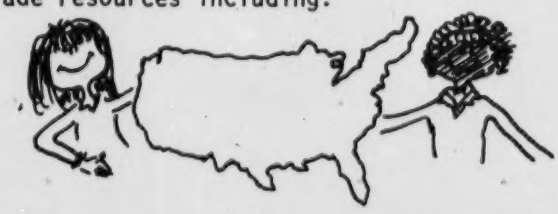
objective: C - The student will know the approximate quantities of high, medium and low grade resources that are available to man.



activities

1. Prepare a map of the U.S. identifying the location of high, medium and low grade resources including:

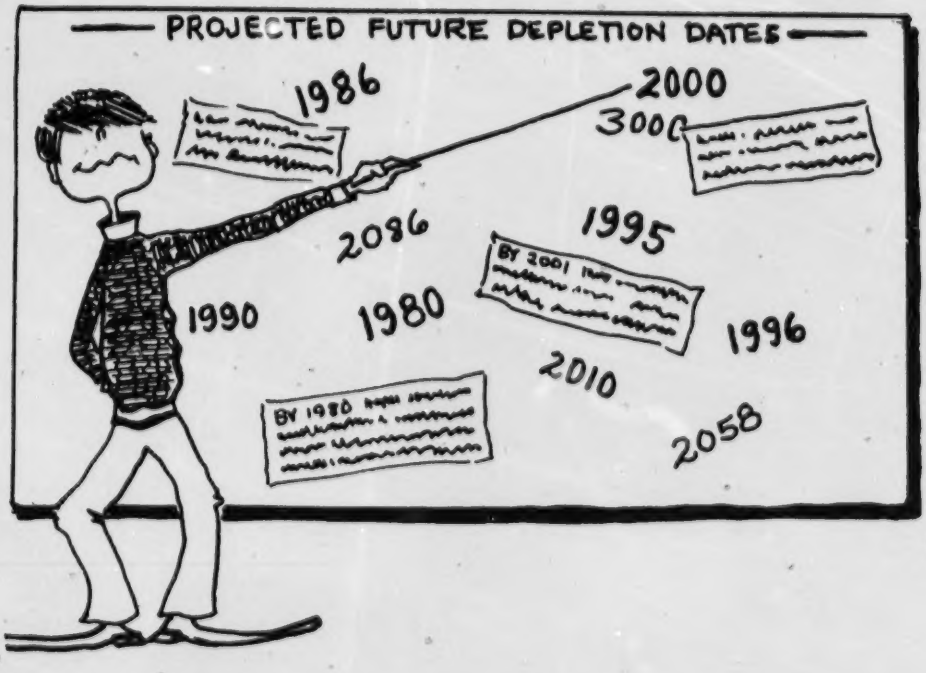
   a. coal
   b. oil
   c. uranium
   d. geothermal
   e. solar
   f. others



2. Using the resources listed compare the rate of use to projected future depletion dates.

3. What are the major high-grade energy sources in the Western Hemisphere? Who has spent the energy to exploit and develop them? Report to your class.

4. Using a recent economic atlas, report on major high-grade energy sources in the Eastern Hemisphere. Your report should be illustrated in a manner appropriate for large group presentation.



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concept: V - High grade (concentrated) energy sources occur in relatively small amounts, and take relatively smaller amounts of "outside" energy to find and recover.

sources

objective: D - The student will understand the difference between exploration (finding) and exploitation (producing).

activities

1. Identify and explain the steps involved in locating (exploring) one or more of the following:

   a. coal
   b. uranium
   c. geothermal
   d. oil
   e. others

2. Prepare diagrams with explanations for the mining or production steps for one or more of the following:

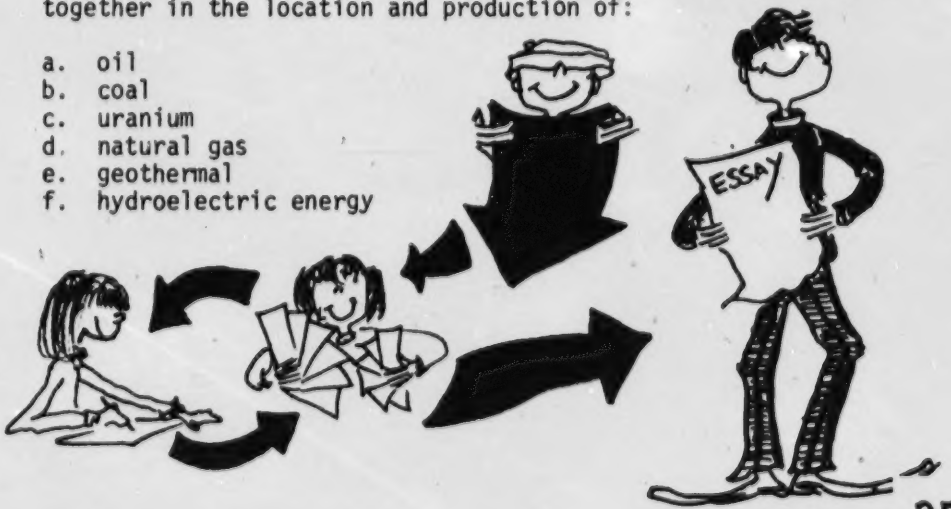
   a. coal
   b. uranium
   c. geothermal
   d. oil
   e. others

3. Make a map of the world depicting only high grade energy deposits. Print directly over each deposit the process used to recover the energy source.

4. Write for and receive information kits from various national and international firms which mine, transport, process or produce energy. Display these materials in your classroom.

5. Write an essay contrasting the work of a geologist and the work of a mining engineer. Pay particular attention to how they work together in the location and production of:

   a. oil
   b. coal
   c. uranium
   d. natural gas
   e. geothermal
   f. hydroelectric energy



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concept: V - High grade (concentrated) energy sources occur in relatively small amounts, and take relatively smaller amounts of "outside" energy to find and recover.

sources

objective: E - New technologies will be used to mine or recover energy sources.

activities

1. Prepare individual diagrams with descriptive materials of how nuclear explosives may be used by ERDA to:

   a. Recover oil from oil shale in place without mining such as ERDA's Project Bronco.

   b. Prepare underground storage cavities for oil and natural gas.

   c. Stimulate the natural gas flow from sandstone deposits in states such as Colorado (Project Rulison).

   d. Compare the environmental impact of obtaining oil from oil shale that is mined and processed for oil extraction above ground versus recovery of the oil in place.

2. Find out what technological changes have occurred in coal mining, reporting about mining practices in 1850, 1900, 1950. What changes would you predict for 2000? 2050?

3. Compare oil-field reactions to natural gas at current times with those of 50 years ago (or 5 years ago in some fields). What new technologies have permitted improved world-wide distribution of natural gas?

4. Secure necessary components, mount and operate a solar cell.

5. Using the New York Times Index identify and explain all newly devised technological devices which can be used to enhance energy production that were discussed in the past year.

6. Visit a home in your area that has installed a solar energy collector and interview the architect that designed the system.

7. Using the information gained above, design a simple collector system that could be used in your school or home.

8. Make a methane generator and burn the methane produced like a gas flame from a gas jet.

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concept: VI - Access to energy sources affects the growth of differing technological, social, governmental, economic and cultural systems.

sources

objective: A - The student will know the dominant energy sources for various cultures, past and present.

activities

1. Using the encyclopedia, locate the following civilizations on a map of the world and indicate their probable source of easily accessible energy.

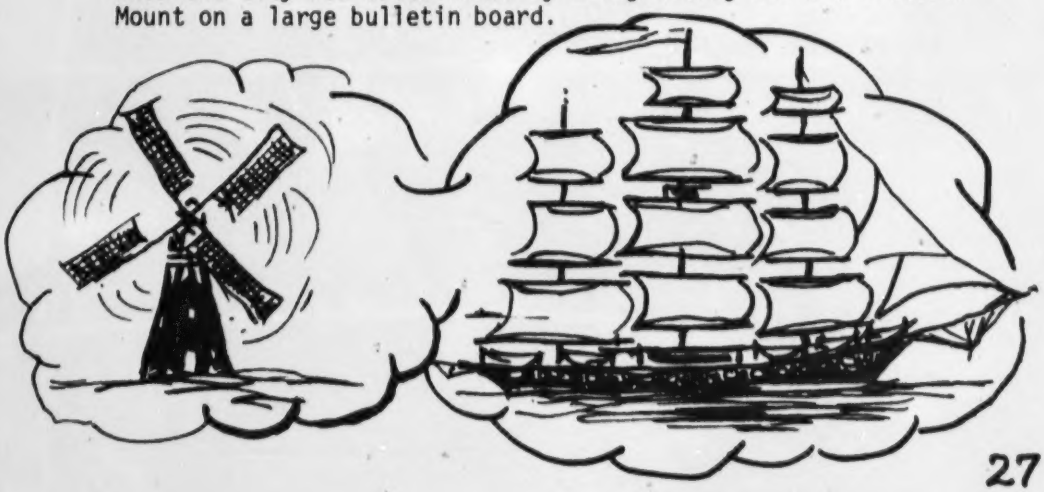
   Egypt (3000 B.C.)
   Greece (500 B.C.)
   Mesopotamia
   England (1600)
   U.S. (1800)
   U.S. (1890)
   U.S. (1960)

2. Visit your local power generation plant or the office of your utility representative to determine where your power comes from. Determine if the sources have changed in the past and what the future sources are likely to be.

3. Correlate the changing patterns of energy use in America over the past 300 years with technological advances using matching time lines.

4. Compare the differences in cultural development brought about by the change from wind power to steam power in England immediately following the "Age of Sail". How did it affect transportation, industry, access to resources, etc.? Answer these questions in a unified essay.

5. Identify major cities that are located on river systems on a world map. Indicate the primary energy source which was used when the city was established by using string and 3 x 5 cards. Mount on a large bulletin board.



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concept: VI - Access to energy sources affects the growth of differing technological, social, governmental, economic and cultural systems.

sources

objective: B - The student will know the flow of energy sources between countries in modern times and how it is likely to change.

activities

1. Map the flow of energy between countries in modern times and project likely changes.

2. On a base map of the world, locate the major sources of energy using current issues of Time, Newsweek or Business Week. Assume that you are the energy Czar for the world. Your assignment is to allocate the available energy resources in the most efficient method, taking into consideration such things as transportation systems, current usage and future needs.

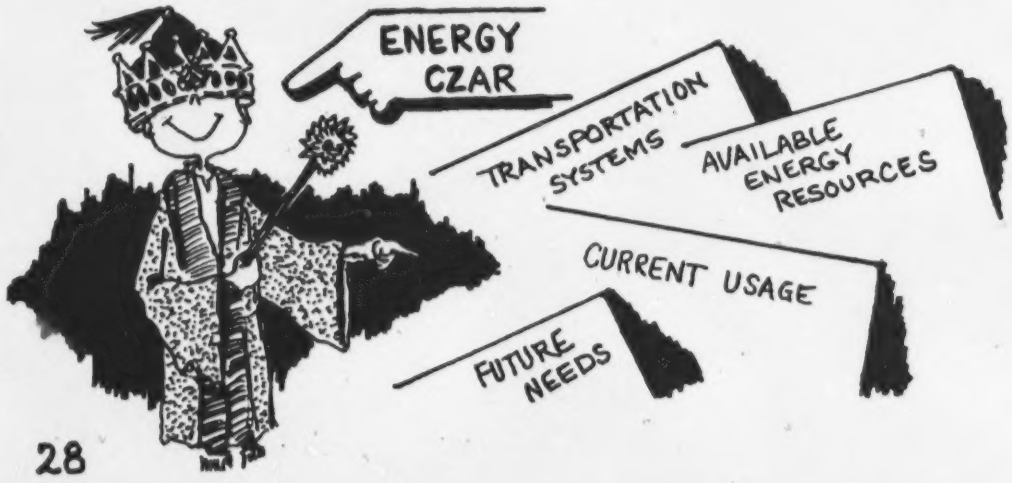
3. Determine which countries exert the greatest influence on the world community at the present time and compare this data with their control over energy resources.

   With this data in hand, postulate which countries will be world leaders in the year 2000. Write a series of scenarios which depict these changes.

4. Collect articles from National Wildlife, Audubon, Aware, Business Week, etc. on various methods of transporting energy, such as VLCC, pipelines, electric transmission lines etc. Prepare a position paper in support of one of the systems taking into consideration such things as danger to environment, efficiency of system, economic advantages.

5. Using a world map, draw arrows of varying sizes between the various world seaports which depict in approximate ratio the importation of oil. (Books on economic geography will be useful.)

6. Do the same as number 5 for oil exports.



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concept: VI - Access to energy sources affects the growth of differing technological, social, governmental, economic and cultural systems.

sources

objective: C - The student will know that the location of cities and industries is often primarily influenced by access to energy sources.

activities

1. Construct a map or a model of a hypothetical area including topography, rivers, coastal areas, etc., and locate a source of energy. With this information map the location of a city including industrial sites, residential sites, road systems, etc.

2. With a map of the eastern half of North America, locate the position of early industrial cities such as Birmingham, Alabama and Richmond, Virginia. Write an essay on the reason for locating these cities so far inland from the sea.

3. Visit the county courthouse to examine early maps of your area to determine the energy reasons why the cities in your county are located where they are.

4. Identify the locations of all major aluminum plants in the world on a world map. Using your world geography texts, determine what common conditions have caused these plants to be so located.

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concept: VI - Access to energy sources affects the growth of differing technological, social, governmental, economic and cultural systems.

sources

objective: D - The student will be aware of the influence of changing access to energy sources on the patterns of cultural development.

activities

1. Divide into groups and select one of the following aspects of American life for research:

   Technology
   Government
   Economics
   Culture

   Using sources such as books, encyclopedia, interviews with grandparents, community leaders, parents, etc. describe the changes that have taken place in America in the 20th century in response to the changes in energy sources and uses.

2. Compile a list of things (articles) in your classroom that are made from petroleum. Assume that the OPEC countries cut off our supply of oil and we have exhausted our domestic supplies. Describe what life will be like in America without petroleum.

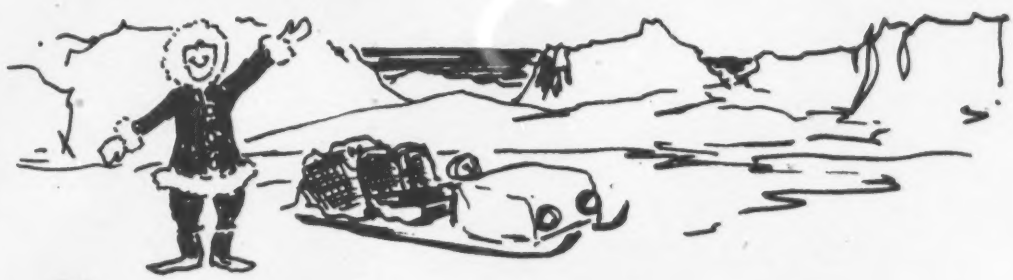
3. Read a book on Eskimo culture at the turn of the century. Postulate the changes that would take place in their culture with the change from dog power to the internal combustion engine.

4. After reading a history of the polder reclamation in the Netherlands determine the various sources of energy used in historical sequence to drain and make the land available for farm usage.

5. Prepare an historical pictogram relating man's significant cultural and technological developments to his discoveries of new energy sources.

6. Compare the life styles of the Coast Salish with Plateau Salish (Washington) in terms of access to various sources of energy. Similar patterns exist with reference to the Dyaks of Borneo.

7. Contrast the war making machines of World War II with the Crusades in terms of energy sources employed.



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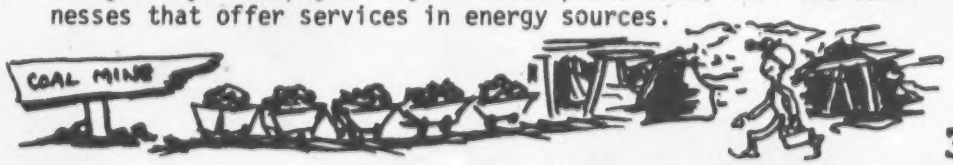
concept: VII - Exploitation of different energy sources results in a variety of occupations.

sources

objective: A - The student will explore the variety of occupations available in energy related industries.

activities

1. Visit a local charcoal production plant. Observe the various occupations involved: furnace operation, packaging, sales, distribution, etc. Record these observations in a series of charcoal sketches.
2. Make a picture collection of the occupations involved in the process of strip-mining which begins with the discovery of the deposit and ends with the sale of the coal.
3. Diagram with a cut-away drawing the process of extracting coal from regular shaft mines. Indicate the occupations involved.
4. Interview local union officials who operate energy related unions regarding career opportunities in their industry and union.
5. Interview a local blacksmith or farmer and observe that person at work.
6. Create a series of illustrations depicting various careers in the energy field. Prepare and display these as a class art exhibit.
7. Photograph every person you see in one day who is involved in an energy-related occupation. Briefly describe each picture in writing; display these for your fellow students.
8. Collect song lyrics or poems about energy-related occupations such as "16 Tons" or Woody Guthrie's lyrics on Grand Coulee. Distribute broadsides to your classmates.
9. Tour a microwave relay station to see how the communications industry relies on electric energy.
10. Visit (or research) a radar installation. Identify various types of careers. Write a report of the job activities for your classmates.
11. Visit a computer facility and diagram its organizational pattern.
12. Use the Occupational Outlook Handbook and identify five energy related occupations and careers which interest you.
13. Using the yellow pages of your local phone book, list the businesses that offer services in energy sources.



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activities

Concept VII
Objective A

14. Plot, on a city map, the location of these businesses. Are energy occupations generally clustered in industrial areas?

15. Prepare a five question survey on career information (number of employees, men/women, annual payroll, etc.) Have each student mail five copies to business firms in your community. Chart or graph your findings.

16. Interview a person from your local natural gas distributor. Where is the original source? Can you find the route it takes to your residential area? How many people are involved in getting it to your homes? What occupations are involved?

17. Interview a person from your local electric company. What is the original source? What substation serves your area? How many people are employed to service your area? What occupations are involved?

18. Interview a person from a local service station. How is his gasoline allotted? How are his deliveries made? What is the source? What jobs are necessary from oil well to gasoline pump?

19. Survey the students in your class. How many parent occupations are related to the various fields of energy?

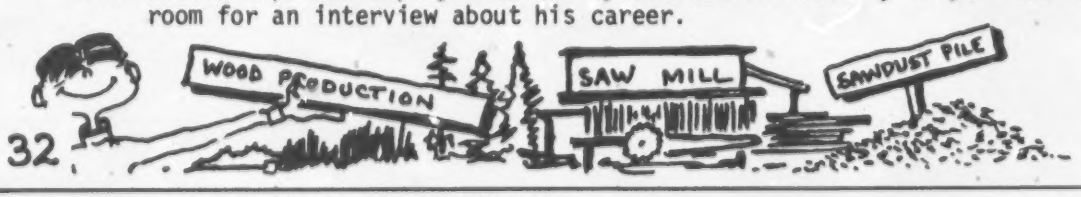
20. List at least five jobs in the production of wood or wood products used as a fuel source.

21. Take a survey of traffic on a busy route near your school. Divide the class into teams to take count in 1/2 hour time periods. Count the vehicles you see that are related to energy sources. Make a separate list of those related to energy uses.

22. Develop a historical time line of the hydroelectric system in the Northwest. List the number of people employed in each project. What new jobs have been created? Can you tell why more people are employed today in building similar systems?

23. Visit a hydroelectric installation. How many people are employed there? List five occupations of people you see at work there. Tell briefly what they do.

24. Invite a person employed in the hydroelectric industry to your classroom for an interview about his career.



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activities

Concept VII
Objective A

25. As a class project develop a collage or montage of pictures, advertisements and other materials related to the sources of energy.

26. In a recent census of manufacturing find how many women are employed in the energy field.

27. List some occupations now open to women that were formerly considered for men only.

28. Interview a woman employed in an occupation formerly considered a man's job.

29. Interview a woman working in an energy source business in your community. Is she something other than a home economist, clerk, secretary, or public relations person?

30. List five occupations for women in the production of electricity.

31. List five occupations for women in the fossil fuel industry.

32. Tour a local oil depot. Find out what jobs are available there. Interview the personnel director and ask him what kinds of people he hires. Are there jobs that are difficult to fill?

33. Interview a representative from the local longshoremen's union. Ask him if there are special requirements for people who work with the loading and unloading of oil and/or petroleum products. How many people are employed in this field in your area?

34. What can you find out about special shipping regulations in your state with regard to the movement of petroleum products? What people are employed in enforcing these regulations?

35. Interview an electrician in your area and explore the various types of activities an electrician does. You might even be able to observe an electrician at work in your school.

36. Draw a large class mural depicting all the energy-related occupations your class can think of.

37. Make a scroll box of energy-related occupations. Use the scroll to spark class discussion of these occupations and any language art activities you feel are appropriate. (A group narrative could be written for the scroll.)

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Concept VII
Objective A

38. Write a series of one-minute TV spots or 30 second radio spot commercials highlighting energy related occupational opportunities. (Include all camera directions.) If VTR apparatus is available film these.

39. Create a bulletin display using safety devices and/or processes employed by energy industries and indicate the number of jobs each safety device or process has created.

40. Invite local writers of environmental impact statements to your class to discuss the nature and extent of their jobs, or have them answer questions about some specific impact statement they have prepared. (BLM, the USFS, Bureau of Reclamation, highway department, and all organizations using federal funds on projects which affect the environment or organizations that are licensed by regulatory agencies must write such statements.)

41. Tour a local acetylene plant and have the manager discuss his business activity.

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